

TITLE

AIR CONDITIONING BLOCK FITTING WITH TWO SURFACE SEALING

CROSS-REFERENCE TO RELATED APPLICATION

5 This application is a divisional application of and
claims the benefit of U.S. Pat. Appl. No. 10/151,396
filed on May 20, 2002, hereby incorporated herein by
reference.

10 FIELD OF THE INVENTION

 The invention relates to a fitting for a vehicle
air conditioning system and more particularly to a block
fitting for coupling tubing segments, the fitting having
a pair of seals wherein one of the pair of seals is a
15 radial seal and the other of the pair of seals is an
axial seal, the fitting militates against leakage during
operation of an air conditioning system upon failure of
one of the pair of seals.

20 BACKGROUND OF THE INVENTION

 In assembly line manufacturing of vehicles, it is
desirable that air conditioning line fittings be secured
using a power nut driver rather than using a torque
wrench. For this reason, peanut or block fittings are
25 often employed.

 Conventional air conditioning systems have employed
block fittings having several shortcomings. The block
fittings of prior art systems include restricted flow

diameters in the tubing within the fitting resulting in undesirable pressure losses. Prior art fittings are typically produced from thick block material resulting in heavy and expensive fittings. Additionally, the
5 prior art fittings are produced with a single o-ring seal. Therefore, if a surface of the tubing or seal becomes damaged, undesirable leakage of refrigerant fluid may occur.

It would be desirable to produce a fitting for use
10 in an air conditioning system which militates against pressure loss, militates against leakage of refrigerant, and is inexpensive to produce.

SUMMARY OF THE INVENTION

15 Consistent and consonant with the present invention, a fitting for use in an air conditioning system which militates against pressure loss, militates against leakage of refrigerant, and is inexpensive to produce has surprisingly been discovered.

20 The fitting for an air conditioning system comprises:

a male tube with an end and an outer wall, the male tube having a radially outwardly extending annular flange formed thereon and an annular groove formed in
25 the outer wall spaced from the end and the annular flange;

a female tube adapted to receive the male tube, the female tube having a flared end to cooperate with the

male tube;

a first o-ring disposed between the annular flange of the male tube and the flared end of the female tube to provide at least an axial seal between
5 the male tube and the female tube;

a second o-ring disposed within the annular groove to provide at least a radial seal between the male tube and the female tube;

a male fitting having an aperture formed therein
10 adapted to receive the male tube;

a female fitting having an aperture formed therein adapted to receive the female tube; and

fastening means for securely holding the male fitting and the female fitting adjacent one another to
15 engage the male tube and the female tube.

BRIEF DESCRIPTION OF THE DRAWINGS

The above, as well as other objects, features, and advantages of the present invention will be understood
20 from the detailed description of the preferred embodiments of the present invention with reference to the accompanying drawings, in which:

Fig. 1 is a sectional elevation view incorporating the features of the present invention;

25 Fig. 2 is a partial sectional view taken along line 2-2 of Fig. 1 showing the male block fitting;

Fig. 3 is a sectional elevation view of an alternate embodiment of the present invention;

Fig. 4 is a partial sectional view taken along line 4-4 of Fig. 3 showing the male block fitting;

Fig. 5 is a sectional elevation view of an alternate embodiment of the present invention;

5 Fig. 6 is a partial sectional view taken along line 6-6 of Fig. 5 showing the male block fitting;

Fig. 7 is a sectional elevation view of an alternate embodiment of the present invention;

10 Fig. 8 is a partial sectional view taken along line 8-8 of Fig. 7 showing the backer plate; and

Fig. 9 is a sectional elevation view of an alternate embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and particularly
15 Fig. 1, there is shown generally at 10 a block or peanut fitting incorporating the features of the invention. The block fitting 10 includes a male block portion 12 and a female block portion 14. As illustrated in
20 Fig. 2, the male block 12 has a generally elliptical shape with one end of the ellipse having a slightly smaller radius than the other end. The male block 12 includes a first generally circular aperture 16 adapted to receive a male tube or conduit 18. It is desirable, although not critical, to have a press fit
25 between the male tube 18 and the wall forming the first aperture 16. Splines formed on the wall forming the first aperture 16 can also be used to accomplish the desired interference fit. In the

embodiment shown, the first aperture 16 is disposed adjacent the end of the ellipse having the larger radius and has a center point on the major axis of the ellipse. The male block 12 includes a second
5 generally circular aperture 20 adapted to receive a stud 22. In the embodiment shown, the second aperture 20 is disposed adjacent the end of the ellipse having the smaller radius and has a center point on the major axis of the ellipse.

10 An annular lip 24 is formed on one side 25 of the male block 12 and is adapted to receive an outer flared portion 26 at the end of a female tube or conduit 28. A flange 30 of the male tube 18, which may be formed by crimping, for example, abuts a side
15 25 of the male block 12 and an inner wall of an outer flared portion 26 of a female tube 28. A gap 32 is left between the flared portion 26 of the female tube 28 and the male tube 18 adjacent the flange 30. The gap 32 is on the side of the flange 30 opposite the
20 side of the flange 30 which abuts the side 25 of the male block 12. A first o-ring 34 is sealingly disposed in the gap 32. An annular groove 36 is formed in the outer surface of the male tube 18, by rolling or machining, for example, near an end 38 of
25 the male tube 18. A second o-ring 40 is disposed in the groove 36 and abuts an inner surface 42 of the female tube 28. An inner flared portion 44 of the female tube 28 is formed adjacent the end 38 of the

male tube 18. Although rubber o-rings are shown in the drawings, it is understood that other conventional sealing materials could be used such as fluoroelastomers, for example.

5 In the embodiment shown, the female block 14 has a generally elliptical shape with one end of the ellipse having a slightly smaller radius than the other end to match the shape of the male block 12. The female block 14 includes a first generally
10 circular aperture 46 adapted to receive the female tube 28. In the embodiment shown, the first aperture 46 is disposed adjacent the end of the ellipse having the larger radius and has a center point on the major axis of the ellipse. An annular ridge 47 surrounds
15 the first aperture 46 of the female block 14 and abuts the outer flared portion 26 of the female tube 28. The female block 14 includes a second generally circular aperture 48 adapted to receive the stud 22. It is desirable, although not critical, to have a
20 press fit between stud 22 and the wall forming the second aperture 48. Splines formed on the wall forming the second aperture 48 can also be used to accomplish the desired interference fit. In the
25 embodiment shown, the second aperture 48 is disposed adjacent the end of the ellipse having the smaller radius and has a center point disposed on the major axis of the ellipse. The stud 22 is inserted through the second aperture 48 of the female block 14 and the

second aperture 20 of the male block 12. A nut 50 threadingly engages the stud 22 to tightly hold the male block 12 adjacent the female block 14 and sealingly engages the male tube 18 and the female tube 28. It is understood that other fasteners could be used without departing from the scope and spirit of the invention.

A second embodiment of the invention is illustrated in Figs. 3 and 4. A block fitting 60' includes a male block portion 62' and a female block portion 14'. As illustrated in Fig. 4, the male block 62' has a generally elliptical shape with one end of the ellipse having a slightly smaller radius than the other end. The male block 62' includes a first generally circular aperture 16' adapted to receive a male tube or conduit 18'. It is desirable, although not critical, to have a press fit between the male tube 18' and the wall forming the first aperture 16'. Splines formed on the wall forming the first aperture 16' can also be used to accomplish the desired interference fit. In the embodiment shown, the first aperture 16' is disposed adjacent the end of the ellipse having the larger radius and has a center point on the major axis of the ellipse. The male block 62' includes a second generally circular aperture 20' adapted to receive a stud 22'. In the embodiment shown, the second aperture 20' is disposed adjacent the end of the ellipse having the smaller

radius and has a center point on the major axis of the ellipse.

A flange 30' of the male tube 18', which may be formed by crimping, for example, abuts a side 64' of the male block 62' and an inner wall of an outer flared portion 26' of a female tube 28'. A gap 32' is left between the flared portion 26' of the female tube 28' and the male tube 18' adjacent the flange 30'. The gap 32' is on the side of the flange 30' opposite the side of the flange 30' which abuts the side 64' of the male block 62'. A first o-ring 34' is sealingly disposed in the gap 32'. An annular groove 36' is formed in an outer surface of the male tube 18', by rolling or machining, for example, near an end 38' of the male tube 18'. A second o-ring 40' is disposed in the groove 36' and abuts an inner surface 42' of the female tube 28'. An inner flared portion 44' of the female tube 28' is formed adjacent the end 38' of the male tube 18'. Although rubber o-rings are shown in the drawings, it is understood that other conventional sealing materials could be used such as fluoroelastomers, for example.

In the embodiment shown, the female block 14' has a generally elliptical shape with one end of the ellipse having a slightly smaller radius than the other end to match the shape of the male block 62'. The female block 14' includes a first generally circular aperture 46' adapted to receive the female

tube 28'. In the embodiment shown, the first aperture 46' is disposed adjacent the end of the ellipse having the larger radius and has a center point on the major axis of the ellipse. An annular ridge 47' surrounds the first aperture 46' of the female block 14' and abuts the outer flared portion 26' of the female tube 28'. The female block 14' includes a second generally circular aperture 48' adapted to receive the stud 22'. It is desirable, although not critical, to have a press fit between stud 22' and the wall forming the second aperture 48'. Splines formed on the wall forming the second aperture 48' can also be used to accomplish the desired interference fit. In the embodiment shown, the second aperture 48' is disposed adjacent the end of the ellipse having the smaller radius and has a center point on the major axis of the ellipse. The stud 22' is inserted through the second aperture 48' of the female block 14' and the second aperture 20' of the male block 62'. A nut 50' threadingly engages the stud 22' to tightly hold the male block 62' adjacent the female block 14' and sealingly engages the male tube 18' and the female tube 28'. It is understood that other fasteners could be used without departing from the scope and spirit of the invention.

A third embodiment of the invention is illustrated in Figs. 5 and 6. A block fitting 80'' includes a male block portion 62'' and a female block

portion 82''. As illustrated in Fig. 6, the male block 62'' has a generally elliptical shape with one end of the ellipse having a slightly smaller radius than the other end. The male block 62'' includes a first generally circular aperture 16'' adapted to receive a male tube or conduit 18''. It is desirable, although not critical, to have a press fit between the male tube 18'' and the wall forming the first aperture 16''. Splines formed on the wall forming the first aperture 16'' can also be used to accomplish the desired interference fit. In the embodiment shown, the first aperture 16'' is disposed adjacent the end of the ellipse having the larger radius and has a center point on the major axis of the ellipse. The male block 62'' includes a second generally circular aperture 20'' adapted to receive a stud 22''. In the embodiment shown, the second aperture 20'' is disposed adjacent the end of the ellipse having the smaller radius and has a center point on the major axis of the ellipse.

A flange 30'' of the male tube 18'', which may be formed by crimping, for example, abuts a side 64'' of the male block 62'' and an inner wall of an outer flared portion 84'' of a female tube 86''. A gap 32'' is left between the flared portion 84'' of the female tube 86'' and the male tube 18'' adjacent the flange 30''. The gap 32'' is on the side of the flange 30'' opposite the side of the flange 30''

which abuts the side 64'' of the male block 62''. A first o-ring 34'' is sealingly disposed in the gap 32''. An annular groove 36'' is formed in an outer surface of the male tube 18'', by rolling or
5 machining, for example, near an end 38'' of the male tube 18''. A second o-ring 40'' is disposed in the groove 36'' and abuts an inner surface 88'' of the female tube 86''. An inner flared portion 90'' of the female tube 86'' is formed adjacent the end 38'' of
10 the male tube 18''. Although rubber o-rings are shown in the drawings, it is understood that other conventional sealing materials could be used such as fluoroelastomers, for example.

In the embodiment shown, the female block 82''
15 has a generally elliptical shape with one end of the ellipse having a slightly smaller radius than the other end to match the shape of the male block 62''. The female block 82'' includes a first generally circular aperture 92'' adapted to receive the female
20 tube 86''. In the embodiment shown, the first aperture 92'' is disposed adjacent the end of the ellipse having the larger radius and has a center point on the major axis of the ellipse. An annular sloped portion 93'' surrounds the first aperture 92''
25 of the female block 82'' and abuts the outer flared portion 84'' of the female tube 86''. The female block 82'' includes a second generally circular aperture 94'' adapted to receive the stud 22''. It

is desirable, although not critical, to have a press fit between stud 22'' and the wall forming the second aperture 94''. Splines formed on the wall forming the second aperture 94'' can also be used to
5 accomplish the desired interference fit. In the embodiment shown, the second aperture 94'' is disposed adjacent the end of the ellipse having the smaller radius and has a center point on the major axis of the ellipse. The stud 22'' is inserted
10 through the second aperture 94'' of the female block 82'' and the second aperture 20'' of the male block 62''. A nut 50'' threadingly engages the stud 22'' to tightly hold the male block 62'' adjacent the female block 82'' and sealingly engages the male tube
15 18'' and the female tube 86''. It is understood that other fasteners could be used without departing from the scope and spirit of the invention.

A fourth embodiment of the invention is illustrated in Figs. 7 and 8. A block fitting 100'''
20 includes a male block portion 62''' and a female block portion 102'''. The male block 62''' has a generally elliptical shape with one end of the ellipse having a slightly smaller radius than the other end. The male block 62''' includes a first
25 generally circular aperture 16''' adapted to receive a male tube or conduit 18'''. It is desirable, although not critical, to have a press fit between the male tube 18''' and the wall forming the first

aperture 16'''. Splines formed on the wall forming the first aperture 16''' can also be used to accomplish the desired interference fit. In the embodiment shown, the first aperture 16''' is
5 disposed adjacent the end of the ellipse having the larger radius and has a center point on the major axis of the ellipse. The male block 62''' includes a second generally circular aperture 20''' adapted to receive a stud 22'''. In the embodiment shown, the
10 second aperture 20''' is disposed adjacent the end of the ellipse having the smaller radius and has a center point on the major axis of the ellipse.

A flange 30''' of the male tube 18'', which may be formed by crimping, for example, abuts a side
15 64''' of the male block 62''' and an inner wall of an outer flared portion 84''' of a female tube 86'''. A gap 32''' is left between the flared portion 84''' of the female tube 86''' and the male tube 18''' adjacent the flange 30'''. The gap 32''' is on the
20 side of the flange 30''' opposite the side of the flange 30''' which abuts the side 64''' of the male block 62'''. A first o-ring 34''' is sealingly disposed in the gap 32'''. An annular groove 36''' is formed in an outer surface of the male tube 18'',
25 by rolling or machining, for example, near an end 38''' of the male tube 18''. A second o-ring 40''' is disposed in the groove 36''' and abuts an inner surface 88''' of the female tube 86'''. An inner

flared portion 90''' of the female tube 86''' is formed adjacent the end 38''' of the male tube 18'''. Although rubber o-rings are shown in the drawings, it is understood that other conventional sealing materials could be used such as fluoroelastomers, for example.

In the embodiment shown, the female block 102''' has a generally elliptical shape with one end of the ellipse having a slightly smaller radius than the other end to match the shape of the male block 62'''. The female block 102''' includes a first generally circular aperture 104''' adapted to receive the female tube 86'''. In the embodiment shown, the first aperture 104''' is disposed adjacent the end of the ellipse having the larger radius and has a center point on the major axis of the ellipse. An annular sloped portion 106''' surrounds the first aperture 104''' of the female block 102''' and abuts the outer flared portion 84''' of the female tube 86'''. The female block 102''' includes a second generally circular aperture 108''' adapted to receive the stud 22'''. It is desirable, although not critical, to have a press fit between stud 22''' and the wall forming the second aperture 108'''. Splines formed on the wall forming the second aperture 108''' can also be used to accomplish the desired interference fit. In the embodiment shown, the second aperture 108''' is disposed adjacent the end of the ellipse

having the smaller radius and has a center point on the major axis of the ellipse.

A backer plate 110''' is disposed adjacent the female block 102''' in a cutout portion 112''' of the female block 102'''. As illustrated in Fig. 8, the backer plate includes a central aperture 114''' adapted to receive the stud 22'''. The backer plate 110''' also includes a pair of shoulder portions 116'''. The stud 22''' is inserted through the aperture 114''' of the backer plate 110'', the second aperture 108''' of the female block 102'', and the second aperture 20''' of the male block 62''. A nut 50''' threadingly engages the stud 22''' to tightly hold the male block 62''' adjacent the female block 102''' and the female block 102''' adjacent the backer plate 110'''. The nut 50''' and the stud 22''' cooperate to sealingly engage the male tube 18''' and the female tube 86'''. It is understood that other fasteners could be used without departing from the scope and spirit of the invention.

A fifth embodiment of the invention is illustrated in Fig. 9. A block fitting 120''' includes a male block portion 62''' and a component block portion 122'''. The component block 122''' is a refrigerant system component such as a condenser block or compressor manifold, for example. The male block 62''' has a generally elliptical shape with one end of the ellipse having a slightly smaller

radius than the other end. The male block 62'''' includes a first generally circular aperture 16'''' adapted to receive a male tube or conduit 18''''. It is desirable, although not critical, to have a press
5 fit between the male tube 18'''' and the wall forming the first aperture 16''''. Splines formed on the wall forming the first aperture 16'''' can also be used to accomplish the desired interference fit. In the embodiment shown, the first aperture 16'''' is
10 disposed adjacent the end of the ellipse having the larger radius and has a center point on the major axis of the ellipse. The male block 62'''' includes a second generally circular aperture 20'''' adapted to receive a threaded stud 124'''. In the
15 embodiment shown, the second aperture 20'''' is disposed adjacent the end of the ellipse having the smaller radius and has a center point on the major axis of the ellipse.

A flange 30'''' of the male tube 18''', which
20 may be formed by crimping, for example, abuts a side 64'''' of the male block 62'''' and an inner wall 126'''' of the component block 122'''. The inner wall 126'''' is adapted to receive the male tube 18'''. A gap 32'''' is left between the inner wall
25 126'''' and the male tube 18'''' adjacent the flange 30'''. The gap 32'''' is on the side of the flange 30'''' opposite the side of the flange 30'''' which abuts the side 64'''' of the male block 62'''. A

first o-ring 34'''' is sealingly disposed in the gap 32''''. An annular groove 36'''' is formed in an outer surface of the male tube 18''', by rolling or machining, for example, near an end 38'''' of the male tube 18'''. A second o-ring 40'''' is disposed in the groove 36'''' and abuts the inner wall 126'''' of the component block 122'''. An inner flared portion 128'''' of the component block 122'''' is formed adjacent the end 38'''' of the male tube 18'''. Although rubber o-rings are shown in the drawings, it is understood that other conventional sealing materials could be used such as fluoroelastomers, for example.

The component block 122'''' includes an aperture 130'''' adapted to receive the stud 124'''. In the embodiment shown, the aperture 130'''' threadingly engages the stud 124'''. It is understood that other fasteners could be used without departing from the scope and spirit of the invention. The stud 124'''' is inserted through the second aperture 20'''' of the male block 62'''. A nut 50'''' threadingly engages the stud 124'''' to tightly hold the male block 62'''' adjacent the component block 122'''' and sealingly engages the male tube 18'''' with the inner wall 126'''' using the first o-ring 34'''' and the second o-ring 40''''.

The assembly and operation of the embodiments of the invention will now be described. To assemble the

embodiment of the invention illustrated in Fig. 1, the male tube 18 is inserted in the first aperture 16 of the male block 12. The female tube 28 is inserted in the first aperture 46 of the female block 14. The first o-
5 ring 34 and the second o-ring 40 are placed on the male tube 18 in the orientation shown in Fig. 1. The male tube 18 is then inserted into the female tube 28 and the male block 12 and the female block 14 are moved adjacent one another. Then, the stud 22 is inserted into the
10 second aperture 48 of the female block 14 and through the second aperture 20 of the male block 12. The nut 50 is then engaged with the threaded portion of the stud 22 and tightened to sealing engage the male tube 18 and the female tube 28.

15 Once assembled, the male block 12 and the female block 14 cooperate to create a sealed, tight fit between the male tube 18 and the female tube 28 and preclude relative axial and rotational movement between the male tube 18 and the female tube 28. The first o-ring 34 and
20 second o-ring 40 provide a seal on two different surfaces. The first o-ring 34 provides an axial seal on the flange 30 of the male tube 18. The second o-ring 40 provides a radial seal between the annular groove 36 of the male tube 18 and the inner wall 42 of the female
25 tube 28. The two surface sealing provides redundant sealing which safeguards against leakage should one of the seals or the sealing surfaces be damaged. Additionally, the seal and tube arrangements allow the

inner diameter through the block fitting 10 to remain substantially the same as the inner diameter of the male tube 18 and the female tube 28, thereby minimizing frictional losses in fluid flow through the connection.

5 To assemble the second embodiment of the invention illustrated in Fig. 3, the male tube 18' is inserted in the first aperture 16' of the male block 62'. The female tube 28' is inserted in the first aperture 46' of the female block 14'. The first o-ring 34' and the
10 second o-ring 40' are placed on the male tube 18' in the orientation shown in Fig. 3. The male tube 18' is then inserted into the female tube 28' and the male block 62' and the female block 14' are moved adjacent one another. Then, the stud 22' is inserted into the second aperture
15 48' of the female block 14' and through the second aperture 20' of the male block 62'. The nut 50' is then engaged with the threaded portion of the stud 22' and tightened to sealing engage the male tube 18' and the female tube 28'.

20 Once assembled, the male block 62' and the female block 14' cooperate to create a sealed, tight fit between the male tube 18' and the female tube 28' and preclude relative axial and rotational movement between the male tube 18' and the female tube 28'. The first o-
25 ring 34' and second o-ring 40' provide a seal on two different surfaces. The first o-ring 34' provides an axial seal on the flange 30' of the male tube 18'. The second o-ring 40' provides a radial seal between the

annular groove 36' of the male tube 18' and the inner wall 42' of the female tube 28'. The two surface sealing provides redundant sealing which safeguards against leakage should one of the seals or the sealing surfaces be damaged. Additionally, the seal and tube arrangements allow the inner diameter through the block fitting 60' to remain substantially the same as the inner diameter of the male tube 18' and the female tube 28', thereby minimizing frictional losses in fluid flow through the connection. In this embodiment, the end of the female tube 28' is protected against damage as it does not protrude beyond the edge of the female block 14' facing the male block 62'.

To assemble the third embodiment of the invention illustrated in Fig. 5, the male tube 18'' is inserted in the first aperture 16'' of the male block 62''. The female tube 86'' is inserted in the first aperture 92'' of the female block 82''. The first o-ring 34'' and the second o-ring 40'' are placed on the male tube 18'' in the orientation shown in Fig. 5. The male tube 18'' is then inserted into the female tube 86'' and the male block 62'' and the female block 82'' are moved adjacent one another. Then, the stud 22'' is inserted into the second aperture 94'' of the female block 82'' and through the second aperture 20'' of the male block 62''. The nut 50'' is then engaged with the threaded portion of the stud 22'' and tightened to sealing engage the male tube 18'' and the female tube 86''.

Once assembled, the male block 62'' and the female block 82'' cooperate to create a sealed, tight fit between the male tube 18'' and the female tube 86'' and preclude relative axial and rotational movement between the male tube 18'' and the female tube 86''. The first o-ring 34'' and second o-ring 40'' provide a seal on two different surfaces. The first o-ring 34'' provides an axial seal on the flange 30'' of the male tube 18'', as well as axial and radial seals on the sloped portion of the outer flared portion 84'' of the female tube 86''. The second o-ring 40'' provides a radial seal between the annular groove 36'' of the male tube 18'' and the inner wall 88'' of the female tube 86''. The two surface sealing provides redundant sealing which safeguards against leakage should one of the seals or the sealing surfaces be damaged. Additionally, the seal and tube arrangements allow the inner diameter through the block fitting 80'' to remain substantially the same as the inner diameter of the male tube 18'' and the female tube 86'', thereby minimizing frictional losses in fluid flow through the connection. In this embodiment, the end of the female tube 86'' is protected against damage as it does not protrude beyond the edge of the female block 82'' facing the male block 62''.

To assemble the fourth embodiment of the invention illustrated in Fig. 7, the male tube 18''' is inserted in the first aperture 16''' of the male block 62'''. The female tube 86''' is inserted in the first aperture

104''' of the female block 102'''. The first o-ring 34''' and the second o-ring 40''' are placed on the male tube 18''' in the orientation shown in Fig. 7. The male tube 18''' is then inserted into the female tube 86'''
5 and the male block 62''' and the female block 102''' are moved adjacent one another. Then, the stud 22''' is inserted into the aperture of the backer plate 110'', the second aperture 108''' of the female block 102'', and through the second aperture 20''' of the male block
10 62'''. The nut 50''' is then engaged with the threaded portion of the stud 22''' and tightened to sealingly engage the male tube 18''' and the female tube 86'''.

Once assembled, the male block 62''' and the female block 102''' cooperate to create a sealed, tight fit
15 between the male tube 18''' and the female tube 86''' and preclude relative axial and rotational movement between the male tube 18''' and the female tube 86'''. Additionally, the backer plate 110''' provides additional support and stiffening for the female block
20 102''' to militate against leakage. The first o-ring 34''' and second o-ring 40''' provide a seal on two different surfaces. The first o-ring 34''' provides an axial seal on the flange 30''' of the male tube 18'', as well as axial and radial seals on the sloped portion
25 of the outer flared portion 84''' of the female tube 86'''. The second o-ring 40''' provides a radial seal between the annular groove 36''' of the male tube 18''' and the inner wall 88''' of the female tube 86'''. The

two surface sealing provides redundant sealing which safeguards against leakage should one of the seals or the sealing surfaces be damaged. Additionally, the seal and tube arrangements allow the inner diameter through the block fitting 100''' to remain substantially the same as the inner diameter of the male tube 18''' and the female tube 86'', thereby minimizing frictional losses in fluid flow through the connection. In this embodiment, the end of the female tube 86''' is protected against damage as it does not protrude beyond the edge of the female block 102''' facing the male block 62'''.

To assemble the fifth embodiment of the invention illustrated in Fig. 9, the male tube 18''' is inserted in the first aperture 16''' of the male block 62'''. The first o-ring 34''' and the second o-ring 40''' are placed on the male tube 18''' in the orientation shown in Fig. 9. The stud 124''' is threaded into the aperture 130''' of the component block 122'''. The male tube 18''' is then inserted into the component block 122''' adjacent the inner wall 126'''. Concurrently, the stud 124''' is inserted into the second aperture 20''' of the male block 62'''. The nut 50''' is then engaged with the threaded portion of the stud 124''' and tightened to sealing engage the male tube 18''' with the inner wall 126''' of the component block 122''' using the first o-ring 34''' and the second o-ring 40'''.

Once assembled, the male block 62'''' and the component block 122'''' cooperate to create a sealed, tight fit and preclude relative axial and rotational movement between the male tube 18'''' and the component
5 block 122''''. The first o-ring 34'''' and second o-ring 40'''' provide a seal on two different surfaces. The first o-ring 34'''' provides an axial seal on the flange 30'''' of the male tube 18'', as well as axial and radial seals on a sloped portion of the inner wall
10 126''. The second o-ring 40'''' provides a radial seal between the annular groove 36'''' of the male tube 18'''' and the inner wall 126''. The two surface sealing provides redundant sealing which safeguards against leakage should one of the seals or the sealing
15 surfaces be damaged. Additionally, the seal and tube arrangement allows the inner diameter through the block fitting 120'''' to remain substantially the same as the inner diameter of the male tube 18'''' thereby minimizing frictional losses in fluid flow through the
20 connection.

By using the configurations illustrated in the drawings, the thickness of the male blocks and the female blocks are also minimized.

From the foregoing description, one ordinarily
25 skilled in the art can easily ascertain the essential characteristics of this invention and, without departing from the spirit and scope thereof, can make various changes and modifications to the invention to adapt it

to various usages and conditions.